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UTILITY
PATENT APPLICATION
TRANSMITTAL

(Only for new nonprovisional applications under 37 C.F.R. § 1.53(b))

Attorney Docket No. 41003.P026
First Inventor or Application Identifier Eric Engstrom
Title A Mobile Digital Communication/Computing Device..
Express Mail Label No. EL605310941US

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

1. * Fee Transmittal Form (e.g., PTO/SB/17)
(Submit an original and a duplicate for fee processing)

2. Specification [Total Pages 18]
(preferred arrangement set forth below)
 - Descriptive title of the Invention
 - Cross References to Related Applications
 - Statement Regarding Fed sponsored R & D
 - Reference to Microfiche Appendix
 - Background of the Invention
 - Brief Summary of the Invention
 - Brief Description of the Drawings (if filed)
 - Detailed Description
 - Claim(s)
 - Abstract of the Disclosure

3. Drawing(s) (35 U.S.C. 113) [Total Sheets 7]

4. Oath or Declaration (unsigned) [Total Pages]
 a. Newly executed (original or copy)
 b. Copy from a prior application (37 C.F.R. § 1.63(d))
(for continuation/divisional with Box 16 completed)
 i. DELETION OF INVENTOR(S)
Signed statement attached deleting
inventor(s) named in the prior application,
see 37 C.F.R. §§ 1.63(d)(2) and 1.33(b).

* NOTE FOR ITEMS 1 & 13: IN ORDER TO BE ENTITLED TO PAY SMALL ENTITY FEES, A SMALL ENTITY STATEMENT IS REQUIRED (37 C.F.R. § 1.27), EXCEPT IF ONE FILED IN A PRIOR APPLICATION IS RELIED UPON (37 C.F.R. § 1.28).

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5. Microfiche Computer Program (Appendix)
6. Nucleotide and/or Amino Acid Sequence Submission
(if applicable, all necessary)
 a. Computer Readable Copy
 b. Paper Copy (identical to computer copy)
 c. Statement verifying identity of above copies

ACCOMPANYING APPLICATION PARTS

7. Assignment Papers (cover sheet & document(s))
8. 37 C.F.R. § 3.73(b) Statement Power of
(when there is an assignee) Attorney
9. English Translation Document (if applicable)
10. Information Disclosure Statement (IDS)/PTO-1449 Copies of IDS
Statement (IDS)/PTO-1449 Citations
11. Preliminary Amendment
12. Return Receipt Postcard (MPEP 503)
(Should be specifically itemized)
 * Small Entity Statement(s) Statement filed in prior application,
(PTO/SB/09-12) Status still proper and desired
13. Certified Copy of Priority Document(s)
(if foreign priority is claimed)
14. Other:

16. If a CONTINUING APPLICATION, check appropriate box, and supply the requisite information below and in a preliminary amendment:
 Continuation Divisional Continuation-in-part (CIP) of prior application No: _____ / _____

Prior application information: Examiner _____

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TOTAL AMOUNT OF PAYMENT (\$)

| Complete if Known | |
|----------------------|------------------|
| Application Number | |
| Filing Date | October 16, 2000 |
| First Named Inventor | Eric Engstrom |
| Examiner Name | |
| Group / Art Unit | |
| Attorney Docket No. | 41003.P026 |

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|----------------------------------|---------------|---------------|---|-------------------|
| 105 | 130 | 205 | 65 Surcharge - late filing fee or oath | |
| 127 | 50 | 227 | 25 Surcharge - late provisional filing fee or cover sheet. | |
| 139 | 130 | 139 | 130 Non-English specification | |
| 147 | 2,520 | 147 | 2,520 For filing a request for reexamination | |
| 112 | 920* | 112 | 920* Requesting publication of SIR prior to Examiner action | |
| 113 | 1,840* | 113 | 1,840* Requesting publication of SIR after Examiner action | |
| 115 | 110 | 215 | 55 Extension for reply within first month | |
| 116 | 380 | 216 | 190 Extension for reply within second month | |
| 117 | 870 | 217 | 435 Extension for reply within third month | |
| 118 | 1,360 | 218 | 680 Extension for reply within fourth month | |
| 128 | 1,850 | 228 | 925 Extension for reply within fifth month | |
| 119 | 300 | 219 | 150 Notice of Appeal | |
| 120 | 300 | 220 | 150 Filing a brief in support of an appeal | |
| 121 | 260 | 221 | 130 Request for oral hearing | |
| 138 | 1,510 | 138 | 1,510 Petition to institute a public use proceeding | |
| 140 | 110 | 240 | 55 Petition to revive - unavoidable | |
| 141 | 1,210 | 241 | 605 Petition to revive - unintentional | |
| 142 | 1,210 | 242 | 605 Utility issue fee (or reissue) | |
| 143 | 430 | 243 | 215 Design issue fee | |
| 144 | 580 | 244 | 290 Plant issue fee | |
| 122 | 130 | 122 | 130 Petitions to the Commissioner | |
| 123 | 50 | 123 | 50 Petitions related to provisional applications | |
| 126 | 240 | 126 | 240 Submission of Information Disclosure Stmt | |
| 581 | 40 | 581 | 40 Recording each patent assignment per property (times number of properties) | |
| 146 | 690 | 246 | 345 Filing a submission after final rejection (37 CFR § 1.129(a)) | |
| 149 | 690 | 249 | 345 For each additional inventor to be examined (37 CFR § 1.129(c)) | |
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APPLICATION FOR UNITED STATES LETTERS PATENT

FOR

**A Mobile Digital Communication/Computing Device
Including Heart Rate Monitor**

Inventor(s):
Eric Engstrom

Prepared by:

COLUMBIA IP LAW GROUP, LLC

"Express Mail" label number EL605310941US

A Mobile Digital Communication/Computing Device Including Heart Rate Monitor

BACKGROUND OF THE INVENTION

5

1. Field of the Invention

The present invention relates to the fields of mobile communication and/or computing devices. More specifically, the present invention relates to the incorporation of bio-metric sensors/monitors in these devices.

10

2. Background Information

Advances in computer and telecommunication technology have led to wide spread adoption of mobile client devices, from the basic wireless telephones to function rich notebook sized computers that pack the power of a desktop computer.

15 In between are web enabled wireless telephones, palmed sized personal digital assistants (PDA) and so forth. As a result, professionals are virtually always only a few clicks or buttons away from their home offices.

20 While these capabilities have increased the mobility of modern professionals, they also have contributed to longer work hours and increased stress for the professionals. However, as society in general becomes more health conscious, notwithstanding their busy work schedules, more and more professionals are allocating time to exercise or participate in physical activities. This trend has not gone unnoticed to the application developers, which as a result have become increasingly interested in incorporating bio-metric data in their applications.

25 Among the modern mobile client devices, unquestionably, wireless mobiles and palm sized PDAs have emerged as the two most popular mobile client devices

for modern professionals. Thus, increasingly, artesian are interested in being able to collect bio-metric data using these devices.

5 **SUMMARY OF THE INVENTION**

A mobile client device, such as a wireless mobile phone or a palm sized personal digital assistant, is provided with a number of sensors and companion programming instructions/circuitry to generate a heart rate reading for a user holding 10 the device. The sensors are used to sense blood flow rate of the user. The sensors are advantageously disposed in a distributed manner, in a number of locations of the mobile client device, to allow collection of multiple blood flow rate readings of the user. The programming instructions/circuitry are used to infer a holding pattern of the device, and generate the heart rate reading using a subset of the sensed data, 15 based at least in part on the inferred holding pattern.

In one embodiment, the sensors are distributively disposed along two edges of the mobile client device, to facilitate collection of blood flow rate data for at least a left hand holding pattern and a right hand holding pattern. In one embodiment, the holding pattern is inferred by comparing the sensed data with one or more reference 20 characteristic profiles. In one embodiment, a set of weights is also selected to normalize the employed sensed data.

BRIEF DESCRIPTION OF DRAWINGS

The present invention will be described by way of exemplary embodiments, but not limitations, illustrated in the accompanying drawings in which like references 5 denote similar elements, and in which:

Figure 1 illustrates a front view of a wireless mobile phone incorporated with heart rate sensors in accordance with one embodiment;

Figure 2 illustrates a front view of a palm sized PDA incorporated with heart rate sensors in accordance with another embodiment;

10 **Figure 3** illustrates an architectural view of the wireless mobile phone and the PDA of **Fig. 1-2**, in accordance with one embodiment;

Figures 4-5 illustrate the operational flow of the relevant aspects of the heart rate application of **Fig. 3**, in accordance with one embodiment;

15 **Figure 6** illustrates an example data structure suitable for use to store the weight data associated with generating the heart rate for practicing the present invention, in accordance with one embodiment; and

Figure 7 illustrates a block diagram view of a circuit suitable for use to practice the present invention, in accordance with one embodiment.

20

DETAILED DESCRIPTION OF THE INVENTION

In the following description, various aspects of the present invention will be described. However, it will be apparent to those skilled in the art that the present 25 invention may be practiced with only some or all aspects of the present invention. For purposes of explanation, specific numbers, materials and configurations are set

forth in order to provide a thorough understanding of the present invention. However, it will also be apparent to one skilled in the art that the present invention may be practiced without the specific details. In other instances, well known features are omitted or simplified in order not to obscure the present invention.

5 Parts of the description will be presented using terms such as end-user interfaces, buttons, and so forth, commonly employed by those skilled in the art to convey the substance of their work to others skilled in the art. Parts of the description will be presented in terms of operations performed by a computing device, using terms such as sensing, converting, comparing, storing, generating and so forth. As
10 well understood by those skilled in the art, these quantities and operations take the form of electrical, magnetic, or optical signals capable of being stored, transferred, combined, and otherwise manipulated through mechanical and electrical components of a digital system. The term digital system includes general purpose as well as special purpose computing machines, systems, and the like, that are standalone,
15 adjunct or embedded.

Various operations will be described in turn in a manner that is most helpful in understanding the present invention, however, the order of description should not be construed as to imply that these operations are necessarily order dependent. Furthermore, the phrase “in one embodiment” will be used repeatedly, however the
20 phrase does not necessarily refer to the same embodiment, although it may.

Referring now to **Figure 1**, wherein a front view of a wireless mobile phone, incorporated with the teachings of the present invention, in accordance with one embodiment, is shown. As illustrated, similar to a conventional wireless mobile phone, wireless mobile phone **100** includes key pad **102**, “talk” and “end talk” buttons **104**, cursor control buttons **106**, display screen **108** and antenna **112**.

However, unlike prior art wireless mobile phones, wireless mobile phone 100 is equipped with a number of sensors **114aa - 114ae** and **114ba – 114be** to sense a number of blood flow rate readings of a user holding wireless mobile phone 100.

Wireless mobile phone 100 is also provided with either companion programming

5 instructions or circuitry (or combination thereof) to generate a heart rate reading for the user using the data sensed by sensors **114aa - 114ae** and **114ba – 114be**.

In accordance with the present invention, sensors **114aa - 114ae** and **114ba – 114be** are advantageously disposed in a distributed manner, at a number of locations of wireless mobile phone 100. For the illustrated embodiments, sensors

10 **114aa - 114ae** and **114ba – 114be** are distributively disposed along the two side edges of wireless mobile phone 100. As a result, the blood flow rate of the user may be sensed at multiple points, more importantly, at different combinations of these points, depending one how mobile phone 100 is held by the user.

For example, if mobile phone 100 is held in a left hand position, the user's

15 thumb and the lower left region of the user's palm are more likely to be in contact with sensors **114aa**, **114ad** and **114ae**, giving three reasonably accurate readings of the user's blood flow rate, while sensors **114ab** and **114ac** most likely will not make very good contact with the user's palm or fingers, yielding unreliable readings of the user's blood flow rate. At the same time, the user's remaining four fingers are more

20 likely to be in contact with sensors **114ba – 114bd**, yielding reliable readings, with sensor **114be** most likely not making very good contact with the user's palm or

fingers, yielding unreliable readings. On the other hand, if mobile phone 100 is held in a right hand position, the user's thumb and the lower right region of the user's palm are more likely to be in contact with sensors **114ba**, **114bd** and **114be**,

25 yielding more reliable readings, with sensors **114bb** and **114bc** most likely not making very good contact with the user's palm or fingers, yielding unreliable

readings. At the same time, the user's remaining four fingers are more likely to be in contact with sensors **114aa – 114ad**, yielding reliable readings, with sensor **114ae** most likely not making very good contact with the user's palm or fingers, yielding unreliable readings.

5 Thus, it can be seen, a user holding pattern (of the mobile phone **100**) can be inferred from the relative strength of the sensing signals generated by the distributively disposed sensors **114aa – 114ae** and **114ba – 114be**. The companion programming instructions/circuitry are designed to do just that, i.e. infer the holding pattern based on the relative strength of the sensing signals. In one embodiment, 10 the companion programming instructions/circuitry make the inference using reference characteristic profiles, to be described more fully below. In turn, the companion programming instructions/circuitry generate the heart rate reading using a subset of the sensing data, based at least in part on the inferred holding pattern. In one embodiment, the employed sensed data are also “normalized” to reflect the 15 different strength a user may employ in holding mobile phone **100**.

For the illustrated embodiment, mobile phone **100** also includes a dedicated service request button **110** to allow the roving user to request for services from different locations or have location information of the user be selectively providing to various recipients. Requesting for service by a roving user is the subject of co-pending U.S. Patent Application, <number to be assigned>, entitled “Method and Apparatus for Roving Request for Service”, filed contemporaneously, and having at least partial common inventorship with the present application. Selective provision of location information of the user to various recipients is the subject matter of co-pending U.S. Patent Application, <number to be assigned>, entitled “Method and Apparatus for People to Simply Communicate Their Location and Activity, also filed 20 contemporaneously, and having at least partial common inventorship with the 25

present application. Except for the recursive incorporation, both of these applications are hereby fully incorporated by reference.

Figure 2 illustrates a front view of a palm sized PDA, incorporated with the teachings of the present invention, in accordance with one embodiment. As illustrated, similar to a conventional PDA, PDA **200** includes display screen **202**, function buttons **204**, and antenna **206**. However, unlike prior art PDA, but similar to wireless mobile phone **100**, PDA **200** is equipped with a number of sensors **208aa - 208ae** and **208ba – 208be** to sense the blood flow rate of a user holding PDA **200**. Also similar to wireless mobile phone **100**, PDA **200** is also provided with either programming instructions or circuitry (or combination thereof) to generate a heart rate reading for the user, using the data sensed by sensors **208aa - 208ae** and **208ba – 208be**.

As wireless mobile phone **100**, sensors **208aa - 208ae** and **208ba – 208be** are advantageously disposed in a distributed manner, at a number of locations of PDA **200**. For the illustrated embodiments, sensors **208aa - 208ae** and **208ba – 208be** are distributively disposed along the two side edges of PDA **200**. As a result, the blood flow rate of the user may also be sensed at multiple points, more importantly, at different combinations of these points, depending on how PDA **200** is held by the user. As described earlier, the companion programming instructions/circuitry are designed to infer the holding pattern based on the relative strength of the sensing signals. In turn, the companion programming instructions/circuitry generate the heart rate reading using a subset of the sensing data, based at least in part on the inferred holding pattern.

Similar to mobile phone **100**, PDA **200** may be equipped with a roving request for service application or a location information distribution application. If so, a service request or location information distribution “home” page may be

retrieved from a messaging service, and rendered on display screen **202**. The service request/location information distribution “home” page may include a “drop down” menu of services available for request, request button, current location and status display. As a result, a user of PDA **200** may also request anyone of the services included in the “drop down” menu, such as calling a taxi, ordering a take out, buying some local wines, and the like, or request the user’s current location information being provided to a number of selected recipients, such as the user’s parent, friends, and so forth, as described in the co-pending incorporated by reference applications.

Figure 3 illustrates an architecture view of a mobile client device **300**, which is intended to be representative of mobile phone **100** and PDA **200**, in accordance with one embodiment. As illustrated, mobile client device **300** includes elements found in conventional mobile client devices, such as micro-controller/processor **302**, digital signal processor (DSP) **304**, non-volatile memory **306**, general purpose input/output (GPIO) interface **308**, and transmit/receive (TX/RX) **312**. For the illustrated embodiment, mobile client device **300** also advantageously includes geographic positioning system **310**, which is equipped to provide a user of mobile client device **300** his/her current location. [However, the provision of GPS **310**, while desirable, is not essential to the practice of the present invention.] Further, mobile client device **300** is provided with sensors **318** (representative of earlier described sensors **114aa - 114ae** and **114ba - 114be** and sensors **208aa - 208ae** and **208ba - 208be**), A/D converter **316**, and heart rate application **320** incorporated with the teachings of the present invention.

Selected ones of sensors **318** (depending a user’s holding pattern) make contact with the user’s palm or fingers, and generate electrical signals proportional to the blood flow rate detected by the sensors. Anyone of a number of such known

sensors may be employed. A/D converter **316** converts the analog electrical signals into digital data. Similarly, anyone of a number of such known A/D converters may be employed. Heart rate application **320** in turn infers the holding pattern, and generate the heart rate accordingly, to be described more fully below. In alternate 5 embodiments, in lieu of heart rate application **320**, mobile client device **300** may be provided with dedicated circuitry for performing the holding pattern inference and heart rate generation operations (also to be described in more details below, referencing **Fig. 7**).

Except for the distributive employment of the sensors, and heart rate 10 generation application **320** (or its circuitry equivalent), the functions and constitutions of the various enumerated elements of **Fig. 3** are known in the art, accordingly will not be otherwise further described either.

Figure 4 illustrates the operational flow of the relevant aspects of the heart rate application of the present invention, in a normal mode of operation, in 15 accordance with one embodiment. As illustrated, at block **402**, heart rate application **320** receives sensing data from the distributively disposed sensors. At block **404**, heart rate application **320** examines the received sensing data and infers a holding pattern of the mobile client device. In one embodiment, heart rate application **320** infers at least whether the mobile client device is being held by the 20 user in a left hand or a right hand position. As alluded earlier, in one embodiment, heart rate application **320** makes the determination by comparing the received sensing data against a number of reference characteristic profiles, depicting the sensing signal characteristics for typical users holding the mobile client device with their left or right hands. [Recall that different sensors are expected to have “lower 25 strength” sensing signals for different holding patterns.] At block **406**, for the illustrated embodiment, heart rate application **320** further loads a set of calibrated

weight corresponding to the determined holding pattern to normalize the subset of sensing data to be used (to reflect the different pressures different users may applied to the sensors when holding the mobile client device). [Recall from earlier description that the unused sensing data are the data generated by sensors that are not expected to make good contact with the user for the particular holding pattern.]

5 At block **408**, heart rate application **320** generates a composite signal, averaging the normalized sensing data. In alternate embodiments, other factors may also be employed to “smooth” the sensing data. At block **410**, heart rate application **320** generates the heart rate reading based on the composite averaged reading (i.e. 10 converting the measured flow rate represented by the signal rate into heart rate).

10 **Figure 5** illustrates the operational flow of the relevant aspects of the heart rate application of the present invention, in a calibration mode of operation, in accordance with one embodiment. At blocks **502-510**, heart rate application **320** essentially performs the same operations as earlier described for blocks **402-410**, 15 when operating in the normal mode, except in block **506**, in lieu of loading a calibrated set of weight as in the case of block **406**, heart rate application **320** loads an initial set of “trial” weights. At block **512**, heart rate application **320** asks the user to confirm if the generated reading using the “trial” weights to normalize the sensing data appear to be sufficiently accurate. The present invention contemplates that the 20 user has a second independent method of learning about the user’s heart rate, to allow the user to calibrate the present invention. At block **514**, heart rate application **320** determines if the user confirms the computed heart rate using the “trial” weights is “sufficiently” accurate. If it is not, heart rate application **320** fetches another set of “trial” weights, and re-performs blocks **508-512**. The process continues until 25 eventually the user confirms that the generated heart rate is sufficiently accurate. At such time, heart rate application **320** saves the last set of “trial” weights as the

“calibrated” weights for the particular holding pattern. The process may be repeated for different holding patterns. Further, in alternate embodiments, in lieu to loading different sets of “trial” weights, the initial set of “trial” weight may be systematically altered (i.e. increased or decreased) to locate the optimal normalization weights.

5 **Figure 6** illustrates a data structure suitable for use to store the weight data for practicing of the present invention. As illustrated, table **600** includes a number of weight sets for left hand holding patterns **602a** and a number of weight sets for right hand holding patterns **602b**. Each weight set **602a** or **602b**, includes a number of weights **604a** for left side sensors **114aa – 114ae** or **208aa – 208ae**, and a number of weights **604b** for right side sensors **114ba – 114be** or **208ba – 208be**. In one embodiment, once calibrated, the “optimal” weight set identifiers for the left and right hand holding patterns are saved in a working area or alternatively, in a configuration register.

10

15 **Figure 7** illustrates a block diagram view of an equivalent circuitry suitable for use to practice the present invention, in accordance with one embodiment. Circuitry **700** comprises counters **702a-702b**, storage units **704a-704b**, comparators **706a-706b**, accumulator **708**, latches **710a-710c**, selector **712** and generator **714**, coupled to each other as shown. Counter **702a** is used to generate a pointer to storage units **704a** to cause storage units **704a** to output a reference sensing data characteristic profile. Comparator **706a** compares the sensing data to the reference characteristic profile. Accumulator **708** accumulates the differences between the sensing data and reference data. Comparator **706b** determines if the accumulated difference is smaller than the previously known smallest accumulated difference. If not, after a pre-determined number of clocks, counter **702a** advances, causing another reference characteristic profile to be output for analysis. Eventually, after a predetermined number of trials or upon convergence towards a “best fit” reference

20

25

characteristic profile, the “best” difference is latched into latch 710b, and the identifier of the characteristic profile is latched into latch 710a.

Thereafter, in like manner, counter 702b successively generates a series of pointers to cause different weight sets to be successively output for different holding patterns for analysis. Latched identifier of the most “fitting” reference characteristic profile causes selector 712 to select the appropriate trial weight sets corresponding to the inferred holding pattern to be examined. The selected trial weight set is then latched and used to normalized the sensing data, and upon normalization, compute the heart rate.

10 The computed heart rate may then be presented to the user for confirmation. The process may be repeated if necessary. Eventually, upon confirmation, the calibrated weight set may then be used during normal mode of operation.

Accordingly, a mobile client device having integrated capabilities for also
15 generating a heart rate reading for a user holding the mobile client device has been described. While the present invention has been described in terms of the above illustrated embodiments, those skilled in the art will recognize that the invention is not limited to the embodiments described. The present invention can be practiced with modification and alteration within the spirit and scope of the appended claims. Thus,
20 the description is to be regarded as illustrative instead of restrictive on the present invention.

CLAIMS

What is claimed is:

- 1 1. A wireless mobile phone comprising:
 - 2 a transceiver for transmitting and receiving signals;
 - 3 a plurality of sensors to sense and output blood flow rate data of a user
 - 4 holding the wireless mobile phone, with the sensors being distributively disposed at
 - 5 a plurality of locations of the wireless mobile phone; and
 - 6 means coupled to the sensors to infer a holding pattern of the wireless mobile
 - 7 phone and to generate a heart rate of the user using a subset of the blood flow rate
 - 8 data output by said sensors, based at least in part on the inferred holding pattern.
- 1 2. The wireless mobile phone of claim 1, wherein the sensors comprise a first
- 2 and a second subset disposed along a first and a second edge of said wireless
- 3 mobile to allow different subsets of said sensors to be primarily relied upon for
- 4 sensing data for different potential holding patterns of said wireless mobile.
- 1 3. The wireless mobile phone of claim 2, wherein said subsets comprise a first
- 2 and a second subset to be primarily relied upon for sensing data for a left hand and
- 3 a right hand holding pattern.
- 1 4. The wireless mobile phone of claim 1, wherein said means comprises means
- 2 to compare sensing data being received from said sensors against a plurality of
- 3 reference characteristic profiles.

1 5. The wireless mobile phone of claim 1, wherein said means comprises means
2 to select a set of weights to be applied to normalize sensing data received from said
3 sensors.

1 6. The wireless mobile phone of claim 1, wherein said means comprises means
2 to request a user to confirm a generated heart rate in a calibration mode of
3 operation.

1 7. The wireless mobile phone of claim 1, wherein said means comprises a
2 plurality of programming instructions designed to perform said inference of a
3 holding pattern of the wireless mobile phone and said generation of a heart rate of
4 the user.

1 8. The wireless mobile phone of claim 1, wherein said means comprises
2 circuitry for performing said inference of a holding pattern of the wireless mobile
3 phone and said generation of a heart rate of the user.

1 9. A palm sized personal digital assistant (PDA) comprising:
2 memory;
3 a processor coupled to the memory;
4 a plurality of sensors to sense and output blood flow rate data of a user
5 holding the PDA, with the sensors being distributively disposed at a plurality of
6 locations of the PDA; and
7 means coupled to the sensors to infer a holding pattern of the PDA and to
8 generate a heart rate of the user using a subset of the blood flow rate data output by
9 said sensors, based at least in part on the inferred holding pattern.

1 10. The PDA of claim 9, wherein the sensors comprise a first and a second
2 subset disposed along a first and a second edge of said PDA to allow different
3 subsets of said sensors to be primarily relied upon for sensing data for different
4 potential holding patterns of said PDA.

1 11. The PDA of claim 10, wherein said subsets comprise a first and a second
2 subset to be primarily relied upon for sensing data for a left hand and a right hand
3 holding pattern.

1 12. The PDA of claim 9, wherein said means comprises means to compare
2 sensing data being received from said sensors against a plurality of reference
3 characteristic profiles.

1 13. The PDA of claim 9, wherein said means comprises means to select a set of
2 weights to be applied to normalize sensing data received from said sensors.

1 14. The PDA of claim 9, wherein said means comprises means to request a user
2 to confirm a generated heart rate in a calibration mode of operation.

1 15. The PDA of claim 9, wherein said means comprises a plurality of
2 programming instructions designed to perform said inference of a holding pattern of
3 the PDA and said generation of a heart rate of the user.

1 16. The PDA of claim 9, wherein said means comprises circuitry for performing
2 said inference of a holding pattern of the PDA and said generation of a heart rate of
3 the user.

1 17. A mobile client device comprising:
2 a plurality of sensors to sense and output blood flow rate data of a user
3 holding the mobile client device, with the sensors being distributively disposed at a
4 plurality of locations of the mobile client device; and
5 means coupled to the sensors to infer a holding pattern of the mobile client
6 device and to generate a heart rate of the user using a subset of the blood flow rate
7 data output by said sensors, based at least in part on the inferred holding pattern.

1 18. The mobile client device of claim 17, wherein the sensors comprise a first and
2 a second subset disposed along a first and a second edge of said mobile client
3 device to allow different subsets of said sensors to be primarily relied upon for
4 sensing data for different potential holding patterns of said mobile client device.

1 19. The mobile client device of claim 17, wherein said means comprises means
2 to compare sensing data being received from said sensors against a plurality of
3 reference sensing data profiles.

1 20. The mobile client device of claim 17, wherein said means comprises means
2 to select a set of weights to be applied to normalize sensing data received from said
3 sensors.

1

ABSTRACT OF THE DISCLOSURE

A mobile client device, such as a wireless mobile or a palm sized personal digital assistant, is provided with a number of sensors and companion programming instructions/circuitry to generate a heart rate reading for a user holding the device. The sensors are used to sense blood flow rate of the user. The sensors are advantageously disposed in a distributed manner, in a number of locations of the mobile client device. The programming instructions/circuitry are used to infer a holding pattern of the device, and generate the heart rate reading, using a subset of the sensed data, based at least in part on the inferred holding pattern.

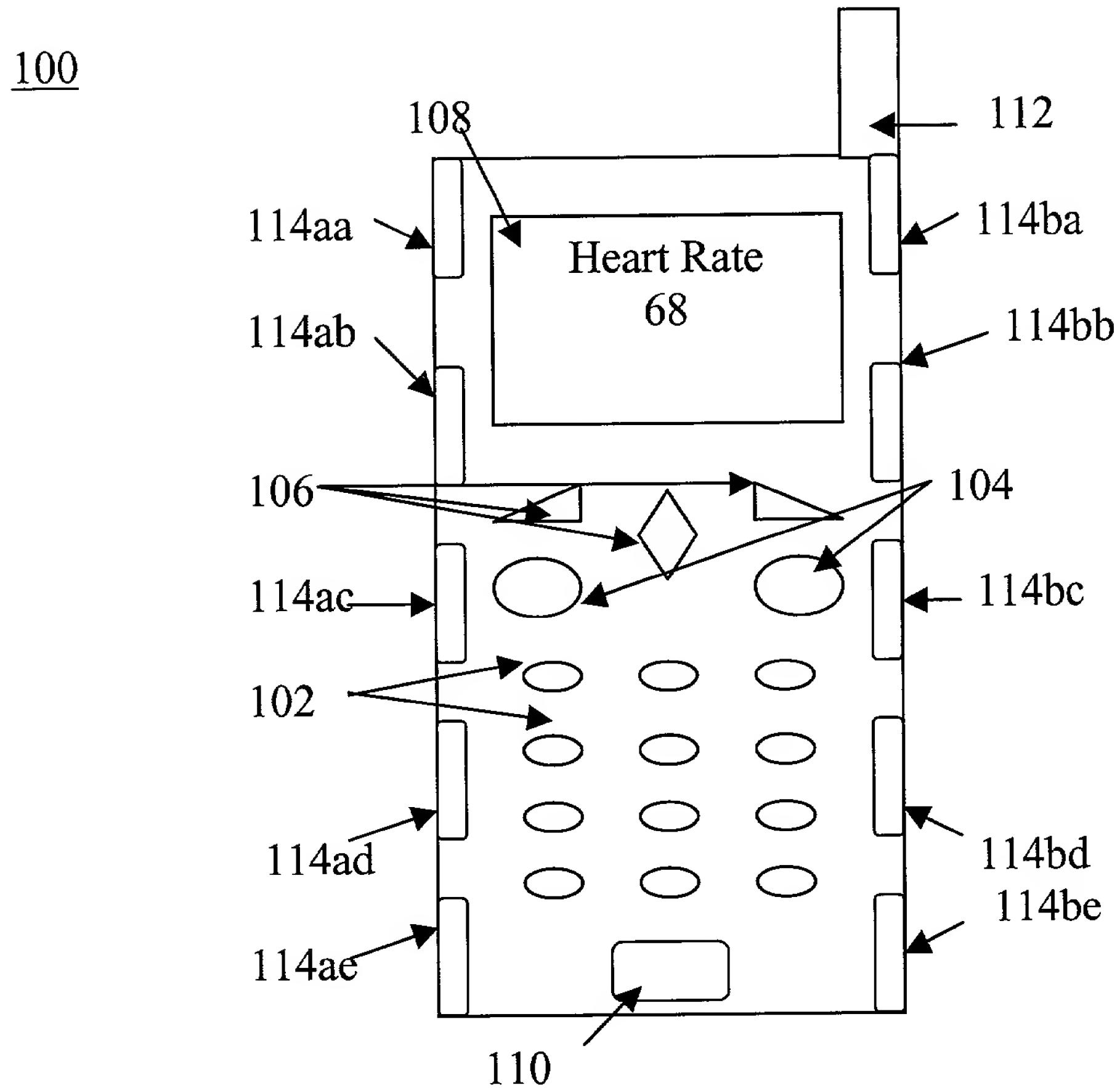


Figure 1

200

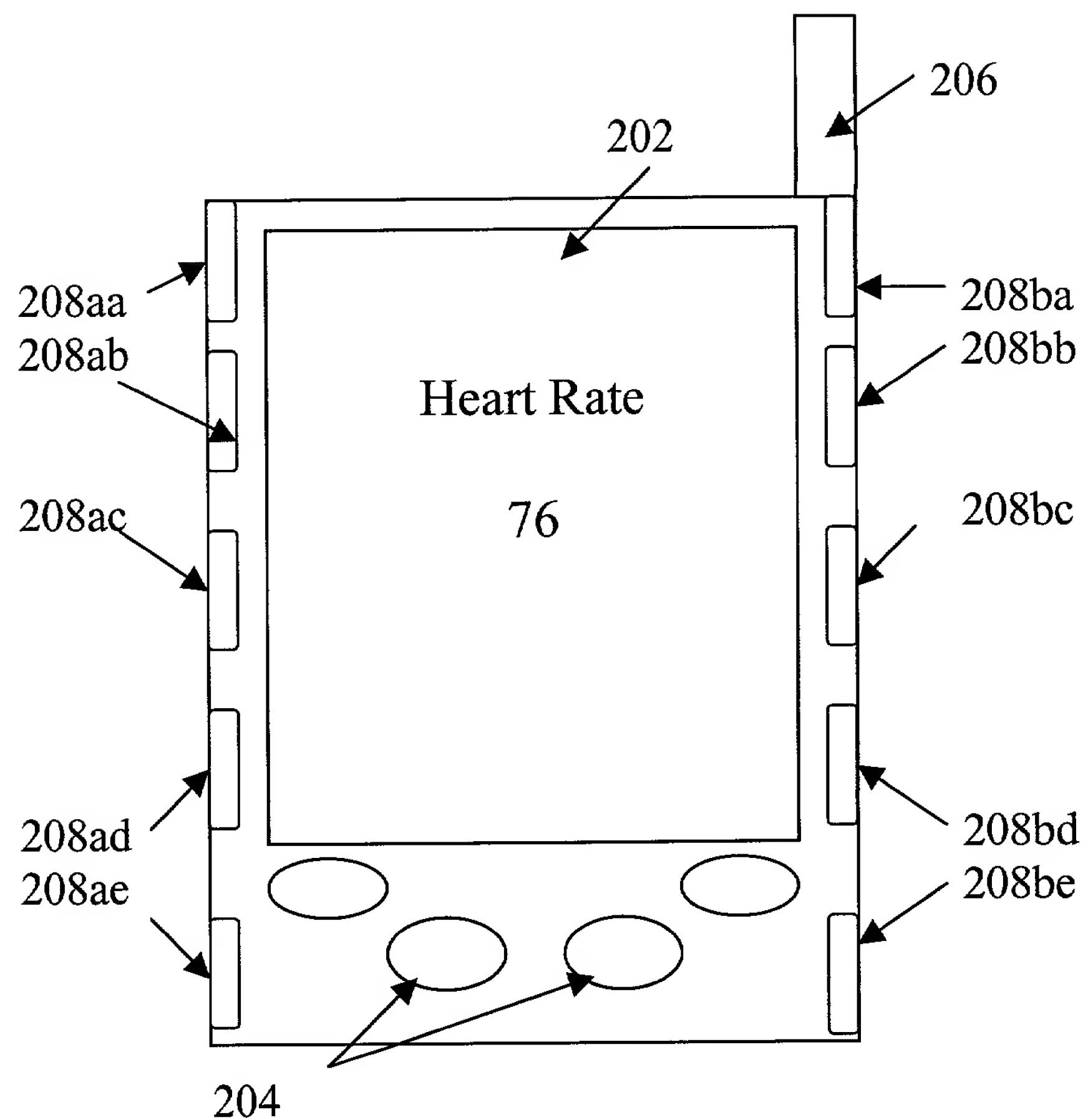


Figure 2

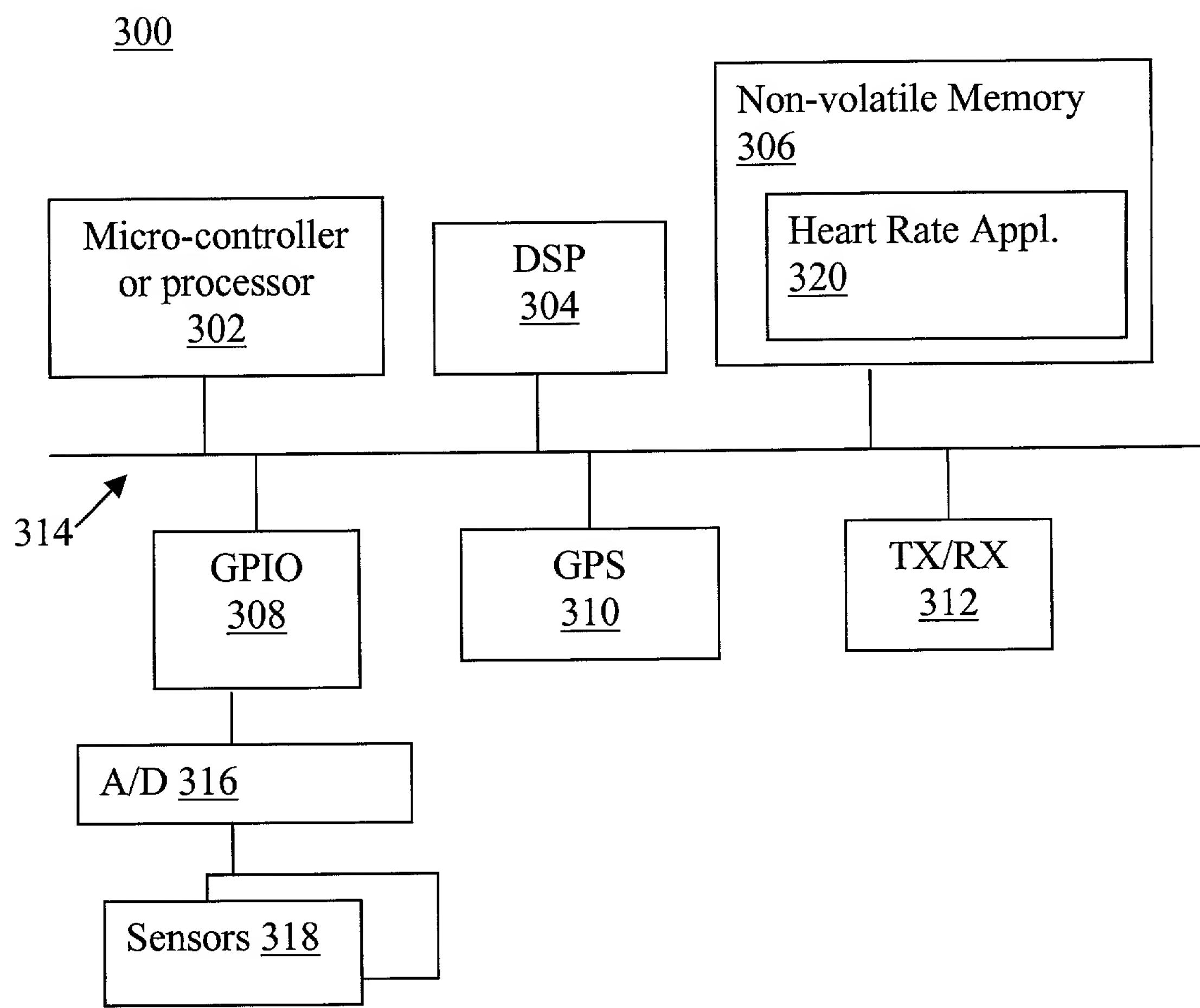


Figure 3

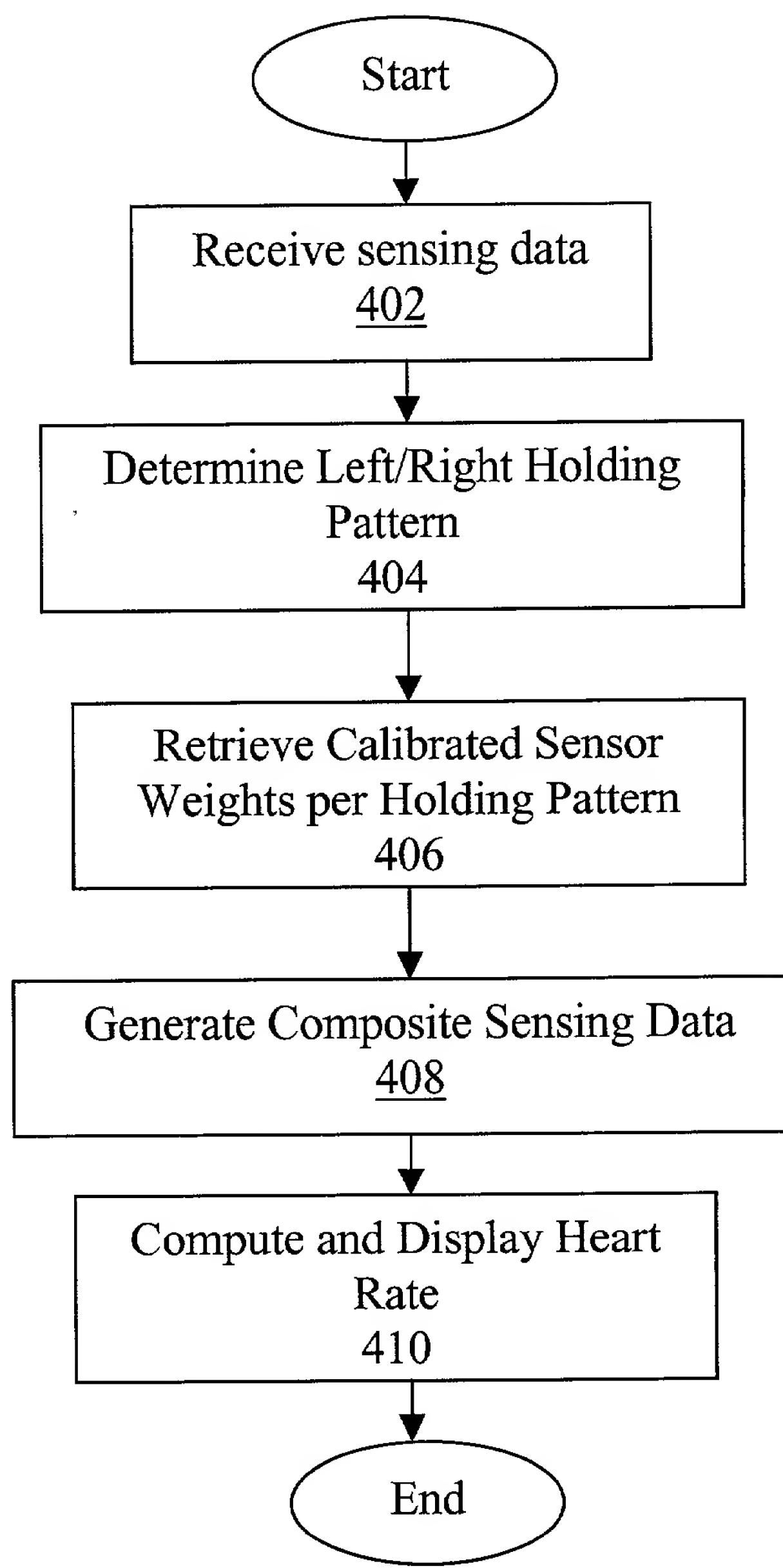


Figure 4

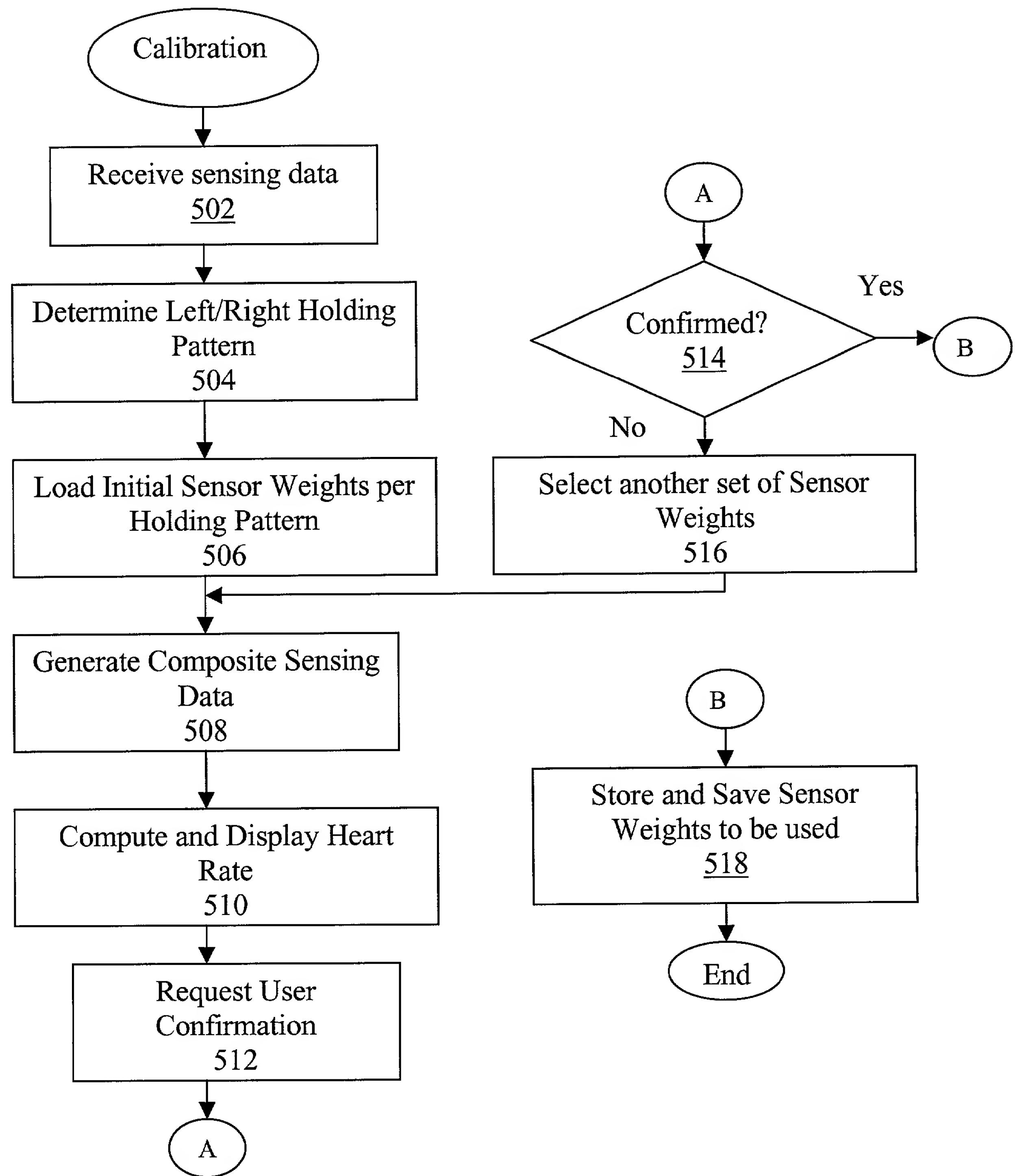
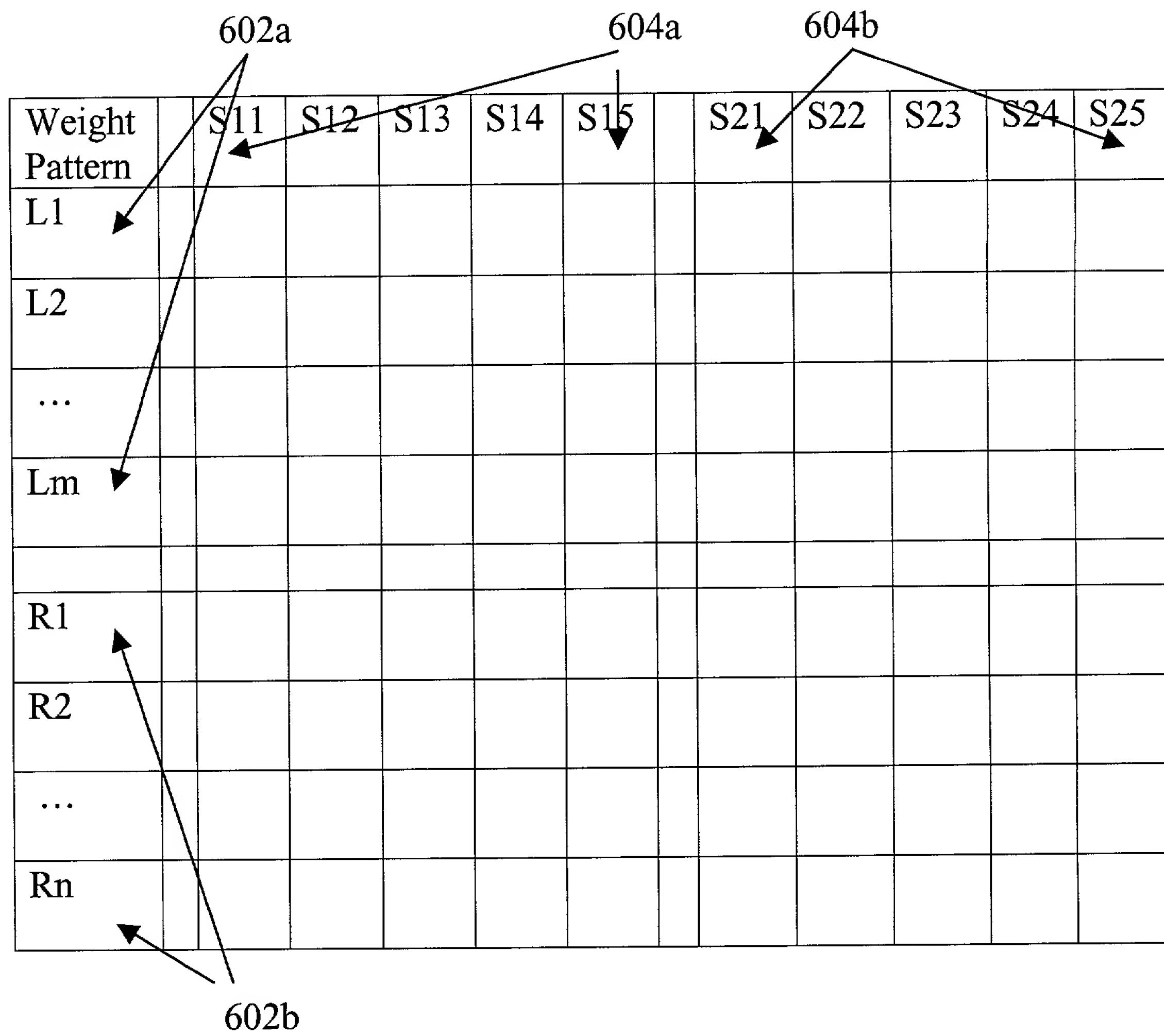


Figure 5



600

Figure 6

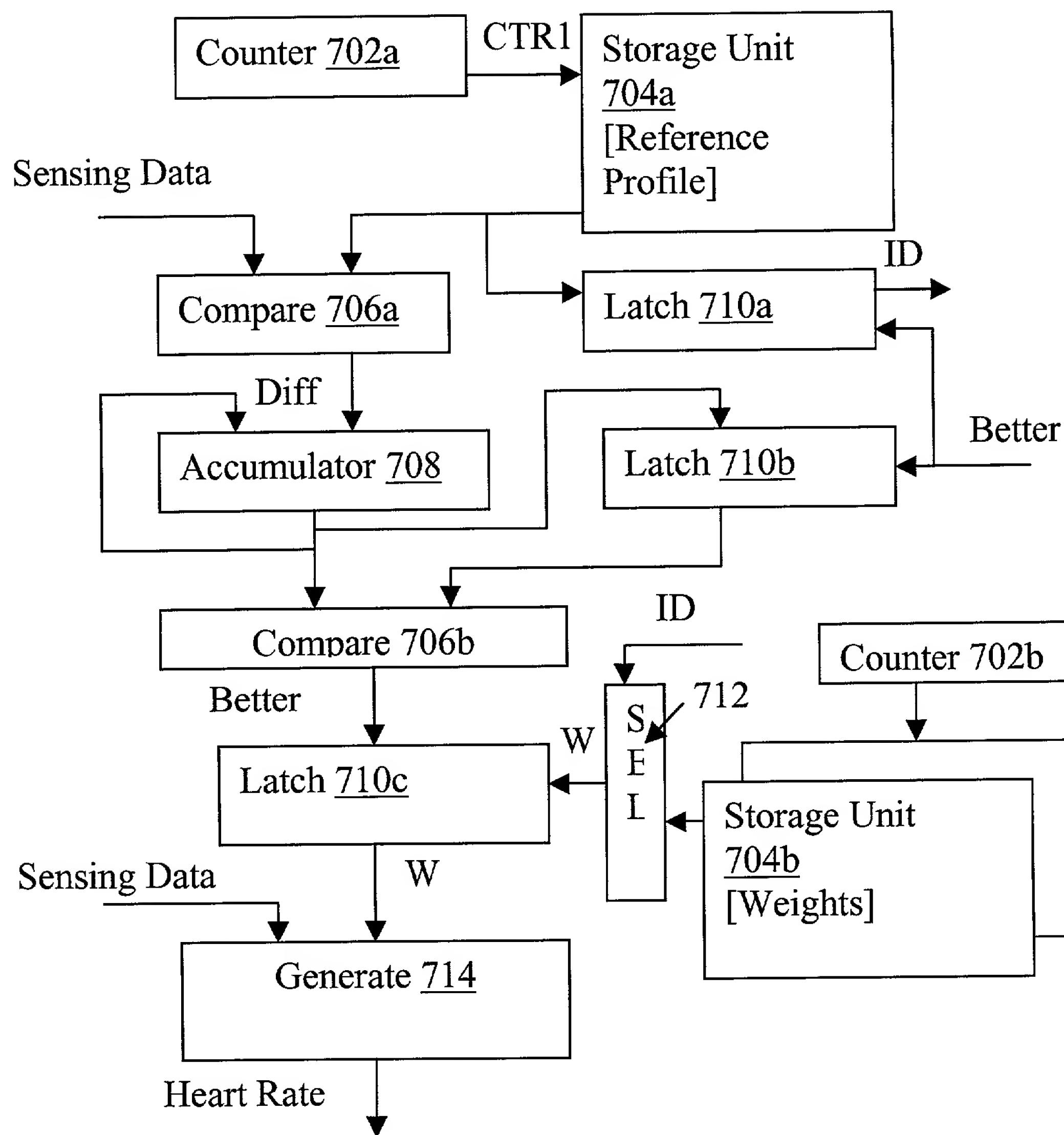


Figure 7

DECLARATION AND POWER OF ATTORNEY FOR PATENT APPLICATION

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below, next to my name.

I believe I am the original, first, and sole inventor (if only one name is listed below) or an original, first, and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

A Mobile Digital Communication/Computing Device Including Heart Rate Monitor

the specification of which

X is attached hereto.
— was filed on _____ as
United States Application Number _____
or PCT International Application Number _____
and was amended on _____.
(if applicable)

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claim(s), as amended by any amendment referred to above.

I acknowledge the duty to disclose all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, Section 119(a)-(d), of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

| <u>Prior Foreign Application(s)</u> | <u>Priority Claimed</u> | | | |
|-------------------------------------|-------------------------|------------------------|-----|----|
| (Number) | (Country) | (Day/Month/Year Filed) | Yes | No |
| _____ | _____ | _____ | Yes | No |
| _____ | _____ | _____ | Yes | No |

I hereby claim the benefit under title 35, United States Code, Section 119(e) of any United States provisional application(s) listed below

_____ (Application Number) _____ Filing Date

(Application Number)

Filing Date

I hereby claim the benefit under Title 35, United States Code, Section 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, Section 112, I acknowledge the duty to disclose all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application:

| (Application Number) | Filing Date | (Status -- patented, pending, abandoned) |
|----------------------|-------------|---|
| | | |

I hereby appoint Aloysius T. C. AuYeung, Reg. No. 35,432; Robert A. Diehl, Reg. No. 40,992, Jason K. Klindtworth (Reg. No. P47,211) and Robert T. Watt (Reg. No. 45,890) my patent attorney/agent; with full power of substitution and revocation, to prosecute this application and to transact all business in the Patent and Trademark Office connected herewith.

Send correspondence to Aloysius T.C. AuYeung,
(Name of Attorney or Agent)
Columbia IP Law Group, LLC, 4900 SW Meadows Rd., Suite 109, Lake Oswego, OR 97035.
and direct telephone calls to Aloysius T.C. AuYeung, (503) 534-2800.
(Name of Attorney or Agent)

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full Name of Sole/First Inventor Eric Engstrom

Inventor's Signature _____ Date _____

Residence Kirkland, Washington Citizenship USA
(City, State) (Country)

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Title 37, Code of Federal Regulations, Section 1.56
Duty to Disclose Information Material to Patentability

(a) A patent by its very nature is affected with a public interest. The public interest is best served, and the most effective patent examination occurs when, at the time an application is being examined, the Office is aware of and evaluates the teachings of all information material to patentability. Each individual associated with the filing and prosecution of a patent application has a duty of candor and good faith in dealing with the Office, which includes a duty to disclose to the Office all information known to that individual to be material to patentability as defined in this section. The duty to disclosure information exists with respect to each pending claim until the claim is cancelled or withdrawn from consideration, or the application becomes abandoned. Information material to the patentability of a claim that is cancelled or withdrawn from consideration need not be submitted if the information is not material to the patentability of any claim remaining under consideration in the application. There is no duty to submit information which is not material to the patentability of any existing claim. The duty to disclosure all information known to be material to patentability is deemed to be satisfied if all information known to be material to patentability of any claim issued in a patent was cited by the Office or submitted to the Office in the manner prescribed by §§1.97(b)-(d) and 1.98. However, no patent will be granted on an application in connection with which fraud on the Office was practiced or attempted or the duty of disclosure was violated through bad faith or intentional misconduct. The Office encourages applicants to carefully examine:

- (1) Prior art cited in search reports of a foreign patent office in a counterpart application, and
- (2) The closest information over which individuals associated with the filing or prosecution of a patent application believe any pending claim patentably defines, to make sure that any material information contained therein is disclosed to the Office.

(b) Under this section, information is material to patentability when it is not cumulative to information already of record or being made or record in the application, and

- (1) It establishes, by itself or in combination with other information, a prima facie case of unpatentability of a claim; or
- (2) It refutes, or is inconsistent with, a position the applicant takes in:
 - (i) Opposing an argument of unpatentability relied on by the Office, or
 - (ii) Asserting an argument of patentability.

A prima facie case of unpatentability is established when the information compels a conclusion that a claim is unpatentable under the preponderance of evidence, burden-of-proof standard, giving each term in the claim its broadest reasonable construction consistent with the specification, and before any consideration is given to evidence which may be submitted in an attempt to establish a contrary conclusion of patentability.

(c) Individuals associated with the filing or prosecution of a patent application within the meaning of this section are:

- (1) Each inventor named in the application;
- (2) Each attorney or agent who prepares or prosecutes the application; and
- (3) Every other person who is substantively involved in the preparation or prosecution of the application and who is associated with the inventor, with the assignee or with anyone to whom there is an obligation to assign the application.

(d) Individuals other than the attorney, agent or inventor may comply with this section by disclosing information to the attorney, agent, or inventor.